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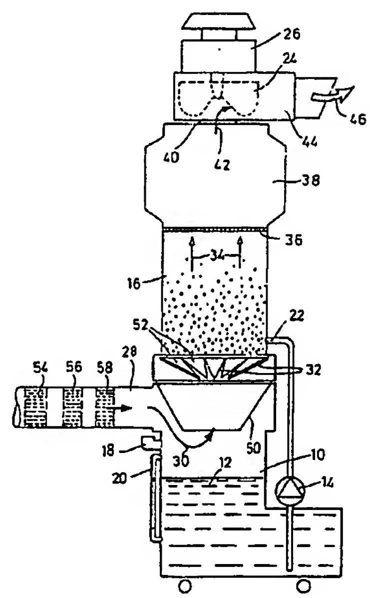
(54) PROCEDE ET DISPOSITIF POUR ENRICHIR DE L'AIR AVEC UN AGENT DE TRAITEMENT D'AIR

(54) METHOD AND DEVICE FOR ENRICHING AIR WITH AN AIR TREATMENT AGENT

(57)
The invention relates to a method for enriching air with an air conditioning agent (12), especially for sterilizing the air. According to the inventive method, an air conditioning agent (12) in the liquid phase is introduced into the air and evaporated. The ratio of conditioning agent in the air ranges from 0.1 to 0.002 ml, preferably from 0.01 to 0.005 ml per m3. According to the inventive device for enriching air with an air conditioning agent (12) a liquid air conditioning agent (12) is provided in a reservoir (10) . Said agent is guided into a turbulence chamber (16). A fan (24) produces an air current (34) in said turbulence chamber. Said air current (34) leads to a turbulence of the liquid air conditioning agent so that a mixture consisting of air and vaporous air conditioning agent is discharged from the turbulence chamber (16).



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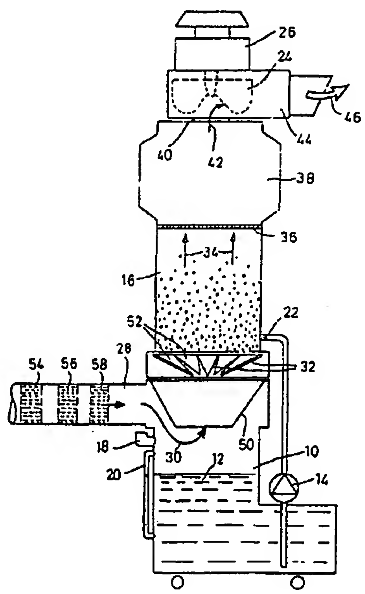


(57) Abrégé/Abstract:
The invention relates to a method for enriching air with an air conditioning agent (12), especially for sterilizing the air. According to the inventive method, an air conditioning agent (12) in the liquid phase is introduced into the air and evaporated. The ratio of conditioning agent in the air ranges from 0.1 to 0.002 ml, preferably from 0.01 to 0.005 ml per m^3. According to the inventive device for enriching air with an air conditioning agent (12) a liquid air conditioning agent (12) is provided in a reservoir (10). Said agent is guided into a turbulence chamber (16). A fan (24) produces an air current (34) in said turbulence chamber. Said air current (34) leads to a turbulence of the liquid air conditioning agent so that a mixture consisting of air and vaporous air conditioning agent is discharged from the turbulence chamber (16).

Abstract

Method and Device for Enriching Air with an Air Treatment Agent

In a method for enriching air with an air treatment agent (12), especially for the disinfection of air, an air treatment agent (12) is introduced into the air and evaporated from a liquid phase. The proportion of treatment agent in the air per m^3 of air is between 0.1 and 0.002 ml, preferably between 0.01 and 0.005 ml. In a device according to the invention for enriching air with an air treatment agent (12), a liquid air treatment agent (12) is provided in a storage vessel (10). It is supplied to a vortexing chamber (16). In the vortexing chamber (16), a current of air (34) produced by a fan (24) exists; it causes the liquid air treatment agent to be vortexed so that a mixture of air and vaporized air treatment agent exits from the vortexing chamber (16).

(Fig. 1)

SMB

Method and Device for Enriching Air with an Air Treatment Agent

The present invention relates to a method and a device for enriching air with an air treatment agent, especially for the disinfection of air.

For example, during the cooling of bakery products after the baking process, it must be avoided that mold germs will settle on the surface prior to packaging. Thus, expensive air-filtering systems with different filter systems are employed. Since the mold germs will deposit in the filtering systems, the filters often act as molding sources themselves. Therefore, the filters must be replaced frequently and cleaned very thoroughly.

Also in the storing of cheese after maturation, undesirable molding occurs on the surface of the cheese from the mold germs present in the air. To avoid this, cheese is coated, for example, with a coating agent which contains an antibiotic. Due to diffusions, the antibiotic penetrates into the external portion of the cheese. The use of filtering systems in cheese production has the same disadvantage as in the production of bakery products.

Another field of application is air treatment in apartments (e.g., of allergic people), office buildings, traffic and conveying means and areas, hygienic areas of productions, storage, packaging, in health service and the like.

Further, for the treatment of air, evaporators are known in which an air treatment agent is evaporated by the addition of heat. When the air treatment agent is evaporated in this manner, the air is enriched with treatment agents to a relatively high extent so that the treatment agent will precipitate in the space to be treated. Even the pulsing of an evaporator which operates by the input of heat cannot avoid

the precipitation of the air treatment agent; the precipitation will only be intermittent.

Also in spraying/compressed air systems, the amount of sprayed air-treatment agent is so large that part of the air treatment agent will precipitate.

For the treatment of cooling rooms for bakery products or storage rooms for cheese, such evaporators cannot be employed, since the air treatment agent would deposit on the food. Also when ambient air is treated, the evaporation of an air treatment agent by the input of heat has the disadvantage that the air treatment agent will precipitate, for example, on cool windows.

It has been the object of the invention to provide a method and a device for enriching air with an air treatment agent, which can also be employed in food areas.

This object is achieved by the features of claims 1 and 9.

In the method according to the invention, the air-treatment agent is introduced into the air and evaporated from a liquid phase. According to the invention, the proportion of treatment agent in the air per m^3 of air is between 0.1 and 0.00001 ml, preferably between 0.01 and 0.0001 ml. When such low amounts of air treatment agent per m^3 of air are used, precipitation of the air treatment agent can no longer be detected. Therefore, the method according to the invention may also be employed for the treatment of air in storage rooms for food. Also in waiting rooms or apartments of allergic people and the like, the use of this method is particularly advantageous because an annoying precipitate on cool windows or the like will not occur.

For a proportion of air treatment agent of as low as 15 ppt (parts per trillion), an average germ reduction of 70% could be detected in an experiment. The proportion of air treatment agent is preferably $\leq$ 100 ppt, more preferably $\leq$ 10 ppt. Already such low amounts of air treatment agent can achieve a germ reduction which corresponds to clean-room conditions.

Preferably, in the method for introducing the air treatment agent into the air, the air treatment agent is first supplied from a storage chamber to a vortexing chamber through which air is flowing. The amount of air supplied to the vortexing chamber and the amount of air treatment agent supplied to the vortexing chamber are adjusted to provide a proportion of air treatment agent of between 0.1 and 0.00001 ml, preferably between 0.01 and 0.0001 ml per m^3 of air per hour. Subsequently, the mixture of air and vaporized air treatment agent is introduced into the space to be treated.

The evaporation of the air treatment agent occurs without the supply of heat. Exclusively due to the vortexing of the air treatment agent, uptake of the low amount of air treatment agent by the air is achieved. The amount of air treatment agent dragged away by the current of air is so low that an aerosol is not formed. The vortexing of the air treatment agent in the vortexing chamber generates a large number of air bubbles. This increases the surface of the air treatment agent in such a way that low amounts of air treatment agent are taken up by the current of air.

The amount of air supplied to the vortexing chamber and the amount of air treatment agent supplied to the vortexing chamber can be established empirically. Care is to be taken that the speed of the current of air is not so high that droplets of air treatment agent are dragged away. On the other hand, too low an amount of air treatment agent contained in the vortexing chamber causes that insufficient vortexing occurs. It has been found that particularly good results can be achieved at a ratio of the amount of air supplied to the amount of air treatment agent supplied of between 45%/55% and 30%/70%. Preferably, this ratio is between 42%/58% and 35%/65%.

Preferably, before being introduced into the space to be treated, the mixture of air and air treatment agent is conducted through an intermediate chamber which is separated from the vortexing chamber by a retaining disk. The function of the intermediate chamber is to allow excess air treatment agent in the air to condensate out. This is supported by the retaining disk, which preferably has fine apertures or is designed as a fine-pore membrane. Thus, the intermediate chamber

serves as a drop separator. This ensures that no aerosol will get into the space to be treated. In the mixture of air and vaporized air treatment agent flowing into the space to be treated, a precipitate cannot be detected with conventional methods.

Since the amount of air treatment agent introduced into the vortexing chamber is significantly higher than the proportion of treatment agent contained in the mixture of air and air treatment agent, excess air treatment agent is discharged from the vortexing chamber. Preferably, the air treatment agent is recirculated into the storage chamber. From here, it can be reintroduced into the vortexing chamber immediately.

For the treatment of air, an antimicrobial composition is especially suitable as an air treatment agent for the disinfection of air. Preferably, the antimicrobial composition contains

(a) one or more GRAS (generally recognized as safe) flavor alcohols or their derivatives; and

(b) one or more flavoring agents selected from

(b1) polyphenol compounds; and

(b2) GRAS flavor acids or their derivatives.

Preferably, the antimicrobial composition contains the GRAS flavor alcohol benzyl alcohol as a necessary component;

The mentioned GRAS flavor alcohols of component (a) are recognized by the FDA authority as commercially safe for use in foods (GRAS = generally recognized as safe in food). The mentioned GRAS flavor alcohols and also the other GRAS flavoring agents defined below are the compounds mentioned in the FEMA/FDA GRAS Flavour Substances Lists GRAS 3-18 Nos. 2001-3905 (as of 1999). This list contains natural and naturally occurring synthetic flavoring agents approved by the American public health authority, FDA, for use in foodstuffs: FDA Regulation 21 CFR 172.515 for naturally occurring synthetic flavoring agents (Synthetic Flavoring Substances and Adjuvants) and FDA Regulation 21 CFR 182.20 for natural flavoring agents (Natural Flavoring Substances and Adjuvants).

The antimicrobial composition defined above under (1) can contain
from 0.1 to 99.9% by weight, preferably from 0.5 to 99% by weight, of component (a);
from 0 to 25% by weight, preferably from 0.01 to 10% by weight, of component (b1); and/or
from 0 to 70% by weight, preferably from 0.01 to 30% by weight, of component (b2).

According to the invention, component (a) may contain one or more GRAS flavor alcohols. It is preferred according to the invention to use two or three GRAS flavor alcohols. In detail, the following GRAS flavor alcohols may be employed, for example:
benzyl alcohol, acetoin (acetylmethylcarbinol), ethyl alcohol (ethanol), propyl alcohol (1-propanol), isopropyl alcohol (2-propanol), isopropanol), propylene glycol, glycerol, n-butyl alcohol (n-propyl carbinol), iso-butyl alcohol (2-methyl-1-propanol), hexyl alcohol (hexanol), L-menthol, octyl alcohol (n-octanol), cinnamyl alcohol (3-phenyl-2-propene-1-ol), α-methylbenzyl alcohol (1-phenylethanol), heptyl alcohol (heptanol), n-amyl alcohol (1-pentanol), iso-amyl alcohol (3-methyl-1-butanol), anisalcohol (4-methoxybenzyl alcohol, p-anisalcohol), citronellol, n-decyl alcohol (n-decanol), geraniol, β-γ-hexenol (3-hexenol), lauryl alcohol (dodecanol), linalool, nerolidol, nonadienol (2,6-nonadiene-1-ol), nonyl alcohol (nonanol-1), rhodinol, terpineol, borneol, clineol (eucalyptol), anisole, cuminyl alcohol (cuminol), 10-undecene-1-ol, 1-hexadecanol. As said derivatives, both natural and synthetic (naturally occurring or not) derivatives can be employed. Suitable derivatives include, for example, the esters, ethers and carbonates of the above mentioned GRAS flavor alcohols. Particularly preferred GRAS flavor alcohols are benzyl alcohol, 1-propanol, glycerol, propylene glycol, n-butyl alcohol, citronellol, hexanol, linalool, acetoin and their derivatives.

As component (b1), the following polyphenols may be employed:
catechol, resorcinol, hydroquinone, phloroglucinol, pyrogallol, cyclohexane, usnic acid, acylpolyphenols, lignins, anthocyans, flavones, catechols, gallic acid derivatives (e.g., tannins, gallotannin, tannic acids, gallotannic acids), including deriva-

tives of the above-mentioned compounds, such as (2,5-dihydroxyphenyl)carboxylic and (2,5-dihydroxyphenyl)alkylenecarboxylic substitutions, salts, esters, amides; caffeic acid and its esters and amides, flavonoids (e.g., flavone, flavonol, isoflavone, gossypetin, myricetin, robinetin, apigenin, morin, taxifolin, eriodictyol, naringin, rutin, hesperidin, troxerutin, chrysin, tangeritin, luteolin, catechols, quercetin, fisetin, kaempferol, galangin, rotenoids, aurones, flavonols, flavonediols), extracts, e.g., from Camellia, Primula. Further, their possible derivatives, e.g., salts, acids, esters, oxides and ethers, may also be used. A particularly preferred polyphenol is tannin (a GRAS compound).

As component (b2), the following GRAS acids may be used, for example:
acetic acid, aconitic acid, adipic acid, formic acid, malic acid (1-hydroxysuccinic acid), capronic acid, hydrocinnamic acid (3-phenyl-1-propionic acid), pelargonic acid (nonanoic acid), lactic acid (2-hydroxypropionic acid), phenoxyacetic acid (glycolic acid phenyl ether), phenylacetic acid (α-toluenic acid), valeric acid (pentanoic acid), iso-valeric acid (3-methylbutyric acid), cinnamic acid (3-phenylpropenoic acid), citric acid, mandelic acid (hydroxyphenylacetic acid), tartaric acid (2,3-dihydroxybutanedioic acid; 2,3-dihydroxysuccinic acid), fumaric acid, tannic acid and their derivatives.

Suitable derivatives of the mentioned acids according to the present invention are esters (e.g., C_{1-6}-alkyl esters and benzyl esters), amides (including N-substituted amides) and salts (alkali, alkaline earth and ammonium salts). According to the present invention, the term "derivatives" also encompasses modifications of the side-chain hydroxy functions (e.g., acyl and alkyl derivatives) and modifications of the double bonds (e.g., the perhydrogenated and hydroxylated derivatives of the mentioned acids).

The mixing ratio of component (a) to component (b) is preferably between 10,000:1 and 1:10,000, more preferably between 1000:1 and 1:1000, and even more preferably between 100:1 and 1:100.

Preferably, the antimicrobial composition contains:

(a1) benzyl alcohol as a necessary component; and optionally
(a2) one or more further GRAS flavor alcohols or their derivatives; and
(b1) one or more polyphenol compounds; and/or
(b2) one or more GRAS acids or their derivatives.

Suitable amounts of components (a1), (a2), (b1) and (b2) are:
from 0.1 to 99% by weight, preferably from 0.1 to 75% by weight, of benzyl alcohol;
from 0 to 99.8% by weight, preferably from 0.01 to 99% by weight, of component (a2);
from 0 to 25% by weight, preferably from 0.01 to 10% by weight, of component (b1); and/or
from 0 to 70% by weight, preferably from 0.01 to 30% by weight, of component (b2).

The antimicrobial composition may further contain the following components (c) to (h), which are also flavoring agents recognized in the FEMA/FDA GRAS Flavour Substances List as GRAS (generally recognized as safe in food) 3-18 Nos. 2001-3905 (as of 1999).

As component (c), the following phenol compounds may be employed:
thymol, methyleugenol, acetyleugenol, safrol, eugenol, isoeugenol, anethole, phenol, methylchavicol (estragol; 3-(4-methoxyphenyl)-1-propene), carvacrol, α-bisabolol, fornesol, anisole (methoxybenzene), propenylguaethol (5-propenyl-2-ethoxyphenol) and their derivatives.

As GRAS esters (component (d)), allicin and the following acetates may be used: iso-amyl acetate (3-methyl-1-butyl acetate), benzyl acetate, benzylphenyl acetate, n-butyl acetate, cinnamyl acetate (3-phenylpropenyl acetate), citronellyl acetate, ethyl acetate (acetic ester), eugenol acetate (acetyleugenol), geranyl acetate, hexyl acetate (hexanyl ethanoate), hydrocinnamyl acetate (3-phenylpropyl acetate), linalyl acetate, octyl acetate, phenylethyl acetate, terpinyl

acetate, triacetin (glyceryl triacetate), potassium acetate, sodium acetate, calcium acetate. Further suitable esters are the ester derivatives of the above defined acids (component (b2)).

As terpenes (component (e)), there may be used, for example, camphor, limonene and β-caryophyllene.

The acetals (component (f)) which can be used include, e.g., acetal, acetaldehyde dibutyl acetal, acetaldehyde dipropyl acetal, acetaldehyde phenethyl propyl acetal, cinnamic aldehyde ethylene glycol acetal, decanal dimethyl acetal, heptanal dimethyl acetal, heptanal glyceryl acetal and benzaldehyde propylene glycol acetal.

As aldehydes (component (g)), there may be used, e.g., acetaldehyde, anisaldehyde, benzaldehyde, iso-butyl aldehyde (methyl-1-propanal), citral, citronellal, n-caprylic aldehyde (n-decanal), ethylvanillin, furfural, heliotropin (piperonal), heptyl aldehyde (heptanal), hexyl aldehyde (hexanal), 2-hexenal (β-propylacrolein), hydrocinnamic aldehyde (3-phenyl-1-propanal), lauryl aldehyde (dodecanal), nonyl aldehyde (n-nonanal), octyl aldehyde (n-octanal), phenylacetaldehyde (1-oxo-2-phenylethane), propionaldehyde (propanal), vanillin, cinnamic aldehyde (3-phenylpropenal), perillaldehyde and cuminaldehyde.

The following essential oils and/or alcoholic or glycolic extracts or extracts obtained by CO_2 high-pressure processes from the mentioned plants (component (h)) can also be employed according to the invention:

(h1) oils or extracts having a high content of alcohols: melissa, coriander, cardamon, eucalyptus;
(h2) oils or extracts having a high content of aldehydes: Eucalyptus citriodora, cinnamon, lemon, lemon grass, melissa, citronella, lime, orange;
(h3) oils or extracts having a high content of phenols: origanum, thyme, rosemary, orange, clove, fennel, camphor, mandarin, anise, cascarilla, estragon and pimento;
(h4) oils or extracts having a high content of acetates: lavender;

(h5) oils or extracts having a high content of esters: mustard, onion, garlic;
(h6) oils or extracts having a high content of terpenes: pepper, bitter orange, caraway, dill, lemon, peppermint, nutmeg.

The proportion of components (c) to (h) in the antimicrobial composition is preferably smaller than or equal to 25% by weight, more preferably within a range of from 0.001 to 9% by weight. Preferred among the further GRAS flavoring agents are the phenols (c) and essential oils (h).

Particularly preferred according to the present invention are antimicrobial compositions in which the antimicrobially active component exclusively consists of GRAS flavoring agents, i.e., which does not contain any "derivatives" of the GRAS flavoring agents. As an example of such a composition, there may be mentioned a mixture of benzyl alcohol, one or two of the above mentioned GRAS flavor alcohols (a2) and tannin. Such a mixture preferably contains from 0.1 to 99.9% by weight, more preferably from 0.1 to 20% by weight, of benzyl alcohol, and from 0.01 to 10% by weight of tannin. Another example of a preferred composition is a mixture of 2 alcohols, a polyphenol (especially tannin) and an essential oil (especially a phenolic essential oil, component (h3)).

In addition to components (a) to (h), further compounds (i), such as alcohols (i1), emulsifiers (i2), stabilizers (i3), antioxidants (i4), preservatives (i5), solvents (i6), carriers (i7), water (i8), etc., may additionally be employed. The proportion of components (i) in the antimicrobial composition may be up to 95% by weight, is preferably smaller than 10% by weight, and is more preferably within a range of from 0.1 to 5% by weight.

According to the invention, the alcohols (i1) are monohydric or polyhydric alcohols having from 2 to 10 carbon atoms, preferably having from 2 to 7 carbon atoms, not including the GRAS alcohols (a). Preferably, the GRAS flavor alcohols (a) and further alcohols (i1) are employed in such amounts that their mixing ratio is between 1000:1 and 1:1000, especially between 100:1 and 1:100, and more preferably between 10:1 and 1:10.

It is preferred to use systems which exclusively consist of GRAS flavoring agents, especially when the treated air will contact food, beverages or packages in food-processing plants, since this also avoids the risk of contamination of the treated foodstuffs with non-GRAS compounds. Further, especiqally when the method according to the invention is applied in food-processing plants or inhabited spaces, it should be taken care that the antimicrobial composition is free from ethanol and isopropanol, or free from harmful doses of ethanol and isopropanol, since these substances can be both absorbed by foods and inhaled by the people in the treated rooms. In addition, when such compounds are used, there may be danger of explosion.

In experimental examples, it could be shown that a reduction factor R_f of 5 to 1 powers of ten can be achieved by the distributing or atomizing of the antimicrobial composition according to the invention, i.e., a reduction of the germs per m^3 of air from 10,000 to 0 is possible.

Thus, the present method is suitable for the disinfection of the air in private households, offices and public buildings as well as in food-processing plants, transport devices, cooling, air-conditioning and other aeration fields. In the latter, a significantly higher stability of the food is achieved by the disinfection of the ambient air (e.g., in the packaging of the food).

A device according to the invention for enriching air with an air treatment agent, which is especially suitable for the disinfection of air, comprises a storage chamber, a vortexing chamber and a means for generating a current of air. The storage chamber contains a liquid air treatment agent. The liquid air treatment agent is supplied to the vortexing chamber, for example, using a pump. Depending on the configuration of the device, the means for generating a current of air can be a fan sucking the mixture out of the vortexing chamber, or a fan blowing air into the vortexing chamber. The fan is arranged in such a way that a current of air is generated in the vortexing chamber due to which the vortexing of the liquid treatment agent is effected. Due to the vortexing of the air treatment agent, the air takes up a small amount of air treatment agent, so that a mixture of air and vaporized air treatment agent exits from the vortexing chamber.

The device according to the invention is suitable for performing the method according to the invention, so that the mixture of air and vaporized air treatment agent exiting from the device has a proportion of air treatment agent per m^3 of air per hour of between 0.1 and 0.00001 ml, preferably between 0.01 and 0.0001 ml. Depending on the kind of treatment agent, the proportion of the treatment agent in the air can be adjusted by the ratio of the amount of air supplied to the amount of treatment agent supplied to the vortexing chamber. It has been found that such a low proportion of treatment agent can be achieved at a ratio of the amount of air to the amount of treatment agent of between 45%/55% and 30%/70%, preferably between 42%/58% and 35%/65%.

Preferably, the vortexing chamber has air inlets in the bottom region through which air flows into the vortexing chamber. Further, excess air treatment agent can drain from the vortexing chamber through the air inlets in a direction opposite to that of the air flow.

In experiments with an air disinfectant, a proportion of treatment agent of 0.01 ml per m^3 of air was achieved at an air flow rate of about 1100 m^3 per hour. Thus, with the above mentioned ratios between the air and the treatment agent, a very low proportion of air treatment agent is taken up by the air, and a major portion of the air treatment agent is discharged from the vortexing chamber. This is a surprising effect, because a very low proportion of air treatment agent is taken up by the air due to the vortexing despite of the very large amount of air treatment agent present in the vortexing chamber. To introduce such low amounts of air treatment agent into the air is not possible with spraying techniques or with thermal evaporation. In particular, it is not possible when known devices are operated without pulsing. However, in the device according to the invention, the above result was achieved without any pulsing.

In order to ensure that actually no precipitating aerosol escapes from the device, an intermediate chamber is provided downstream of the vortexing chamber. Between the intermediate chamber and the vortexing chamber, a retaining disk is provided. Any droplets of air treatment agent dragged away by the current of air

are retained by the retaining disk, on the one hand, and will condensate out in the intermediate chamber, on the other hand.

Preferably, filters are inserted upstream of the air inlets of the vortexing chamber in order to supply air to the device which is as much as possible free of germs, particles and bacteria. For this purpose, a particle filter and/or a bacterial filter and/or a moisture filter are provided.

Advantageously, the device is coupled to an air conditioning system, so that a distribution of the air treatment agent throughout the space is ensured by the air conditioning system.

In another embodiment, a pressure generating means is provided downstream of the device to increase the pressure of the exiting mixture of air and vaporized air treatment agent. Such a device can be used, for example, to ensure that the mixture is blown also into the corners of a room.

To a device with a pressure generating means connected thereto, a lance with air outlets can be connected. The lance can be inserted into food packages in order to introduce the air treatment agent into the package.

With the device described here, the above defined antimicrobial compositions, in particular, can be released into the air.

In the following, the invention will be further illustrated in preferred embodiments thereof with reference to the accompanying drawings:

Figure 1 shows a schematic lateral view of the device for enriching air; and

Figure 2 shows a device which corresponds to the device represented in Figure 1 with a pressure generating means provided downstream.

A storage chamber 10 contains air treatment agent 12. The air treatment agent 12 is pumped from the storage chamber 10 into a vortexing chamber 16 using a pump 14. Further, the storage chamber 10 is provided with a filler neck 18 for

replenishing air treatment agent 12 and with a level indicator 20 having the shape of a transparent tube.

The air treatment agent 12 pumped from the storage chamber 10 into the vortexing chamber 16 is supplied to the vortexing chamber 16 through an inlet 22. Depending on the pump pressure and the size of the inlet 22, the air treatment agent 12 is injected into the vortexing chamber 16 at different pressures. This injection of the air treatment agent 12 can increase the vortexing effect in the vortexing chamber 16.

Using a fan 24 serving as a means for generating a current of air and driven by a motor 26, air is sucked through an air supply duct 28 into the upper region of the storage chamber 10. From there, the air enters the vortexing chamber 16 in the direction of arrow 30 through air inlets 32 provided in the bottom region of the vortexing chamber 16. From there, the air current enters an intermediate chamber 38 in the direction of arrows 34 through a retaining disk 36. From the intermediate chamber 38, the mixture of air and air treatment agent enters a fan chamber 44 through a tubular connection piece 40 in the direction of arrow 42, and from there, it enters the space to be treated in the direction of arrow 46.

The air inlets 32 provided in the bottom region of the vortexing chamber 16 are radially arranged slots through which the air enters the vortexing chamber 16. Since the amount of air treatment agent 12 supplied to the vortexing chamber 16 is higher than the proportion of air treatment agent in the mixture exiting the device, a major portion of the air treatment agent 12 must be recirculated from the vortexing chamber 16 into storage chamber 10. In the embodiment shown, the excess air treatment agent 12 flows through the slot-shaped air inlets 32 back into the storage chamber 12. For this purpose, the bottom region of the vortexing chamber 16 in which the air inlets 32 are provided has a funnel-shaped design. In order to ensure a well-aimed backflow of the excess air treatment agent, a funnel 50 is provided in the upper region of the storage chamber 10. Further, the funnel 50 prevents air treatment agent 12 from getting into the air supply duct 28.

The slot width of the air inlets 32 can be adjusted because the bottom region consists of individual triangular segments 52 whose inclination angle can be adjusted. The steeper the segments 52 are arranged, the larger are the slot-shaped air inlets 32.

The mixture of air and air treatment agent exiting from the vortexing chamber 16 is conducted through the retaining disk 36 into the intermediate chamber 38. The retaining disk 36 has apertures of low diameter or consists of a membrane having a fine porosity. The retaining disk 36 retains any droplets of air treatment agent dragged away by the current of air, so that only vaporized air treatment agent gets into the intermediate chamber 38, if possible.

The intermediate chamber 38 is provided as an additional safeguard. It ensures that any air treatment agent present in the mixture of air and air treatment agent which is not in a vaporized form will condensate out in the intermediate chamber 38. The portion of the air treatment agent which condensates out on the walls of the intermediate chamber 38 flows through the retaining disk 36 back into the vortexing chamber 16. From the intermediate chamber 38, a mixture of air and vaporized air treatment agent exclusively enters the fan chamber 44 along the arrow 42. The mixture entering the fan chamber 44 does not contain any more aerosol, so that the small amount of air treatment agent present in the mixture can no longer be detected as a precipitate.

In the air supply duct 28, a particle filter 54, especially a pollen filter, a bacterial filter 56 and a moisture filter 58, is provided for filtering the air sucked in. The moisture filter 58 withdraws the moisture from the air sucked in because the air treatment agents used are often hygroscopic.

To the fan chamber 44, a pressure generating means 60 (Figure 2) can be connected. In the example shown, this is a two-step pressure generating means having a first pressure generating step 62 and a second pressure generating step 64. After the pressure generating means 60, the mixture of air and air treatment agent is introduced into a flexible tube 66 under increased pressure. To the flexible

tube 66, a lance 68 with outlets 70 is connected. The lance 68 can be inserted into food packages to fill them with the mixture of air and air treatment agent.

When an air disinfectant is discharged by the device according to the invention, it can be introduced into packages of rolls and the like instead of nitrogen. The air disinfectant causes death of the mold germs present on the rolls. This ensures that the rolls cannot start to mold even when there are small apertures, which frequently occur in the welding seams of the package. This is not the case when nitrogen or the like is used, because nitrogen only suppresses the formation of mold. This means that the rolls start to mold as soon as fresh air gets into the package. When an air disinfectant is used, mold germs must also intrude into the package in addition to fresh air. Generally, it is not possible for them to intrude through the very small apertures in the welding seams. The use of air disinfectants in packages significantly reduces the risk of molding of the food contained.

CLAIMS:

1. A method for enriching air with an air treatment agent (12), especially for the disinfection of air, wherein said air treatment agent (12) is introduced into the air and evaporated from a liquid phase, wherein the proportion of treatment agent in the air per m^3 of air is between 0.1 and 0.00001 ml, preferably between 0.01 and 0.0001 ml.

2. The method according to claim 1, which comprises the following steps for introducing the air treatment agent (12) into the air:

   - feeding the air treatment agent (12) from a storage chamber (10) into a vortexing chamber (16) through which air is flowing;

   - adjusting the supplied amount of air and the supplied amount of air treatment agent (12) to achieve a proportion of treatment agent of between 0.1 and 0.00001 ml, preferably between 0.01 and 0.0001 ml, per m^3 of air per hour; and

   - introducing the mixture of air and vaporized air treatment agent (12) into a room to be treated.

3. The method according to claim 2, characterized in that the ratio of the amount of air supplied to the amount of air treatment agent (12) supplied is between 45%/55% and 30%/70%, preferably between 42%/58% and 35%/65%.

4. The method according to claim 2 or 3, wherein the mixture of air and air treatment agent (12), before being introduced into the space to be treated, is conducted through an intermediate chamber (38) which is separated from the vortexing chamber (16) by a retaining disk (36).

5. The method according to any of claims 2-4, wherein excess air treatment agent (12) is recirculated into the storage chamber (10).

6. The method according to any of claims 1-5, wherein the proportion of air treatment agent in the air is ≤ 100 ppt, preferably ≤ 10 ppt.

7. The method according to any of claims 1-6, wherein an antimicrobial composition is used as said air treatment agent (12).

8. The method according to claim 7, wherein said antimicrobial composition contains one or more GRAS flavoring agents or their derivatives.

9. A device for enriching air with an air treatment agent (12), especially for the disinfection of air, comprising:

   a storage vessel (10) for receiving liquid air treatment agent (12);

   a vortexing chamber (16) to which liquid air treatment agent (12) is supplied; and

   a means (24) for generating a current of air in said vortexing chamber (16), so that vortexing of the liquid treatment agent (12) is effected by the current of air (30, 34), and a mixture of air and vaporized air treatment agent (12) exits from the vortexing chamber (16).

10. The device according to claim 9, characterized in that the ratio of the amount of air supplied to the vortexing chamber (16) to the amount of air treatment agent (12) supplied to the vortexing chamber (16) is between 45%/55% and 30%/70%, preferably between 42%/58% and 35%/65%.

11. The device according to claim 9 or 10, characterized in that air inlets (32) are provided in the bottom region of the vortexing chamber (16) through which excess air treatment agent (12) can drain in a direction opposite to that of the air flow.

12. The device according to claim 11, characterized in that said vortexing chamber (16) and said storage chamber (10) have a common separation wall in which said air inlets (32) are provided.

13. The device according to any of claims 11-12, characterized in that said air inlets (32) are slots, especially radially arranged slots.

14. The device according to any of claims 11-12, characterized in that bottom region in which the air inlets (32) are provided is funnel-shaped.

15. The device according to any of claims 10-14, characterized in that an intermediate chamber (38) is provided downstream of the vortexing chamber (16), which intermediate chamber is separated from the vortexing chamber (16) by a retaining disk (36) which has transfer apertures.

16. The device according to any of claims 10-14, characterized in that a particle filter (54) and/or a bacterial filter (56) and/or a moisture filter (58) are inserted upstream of the air inlets (32).

17. The device according to any of claims 10-16, characterized in that a pressure generating means (60) is provided downstream to increase the pressure of the exiting mixture of air and vaporized air treatment agent (12).

18. The device according to claim 17, characterized in that a lance (68) is connected to said pressure generating means (60) in order to introduce the mixture of air and vaporized air treatment agent (12) into food packages.

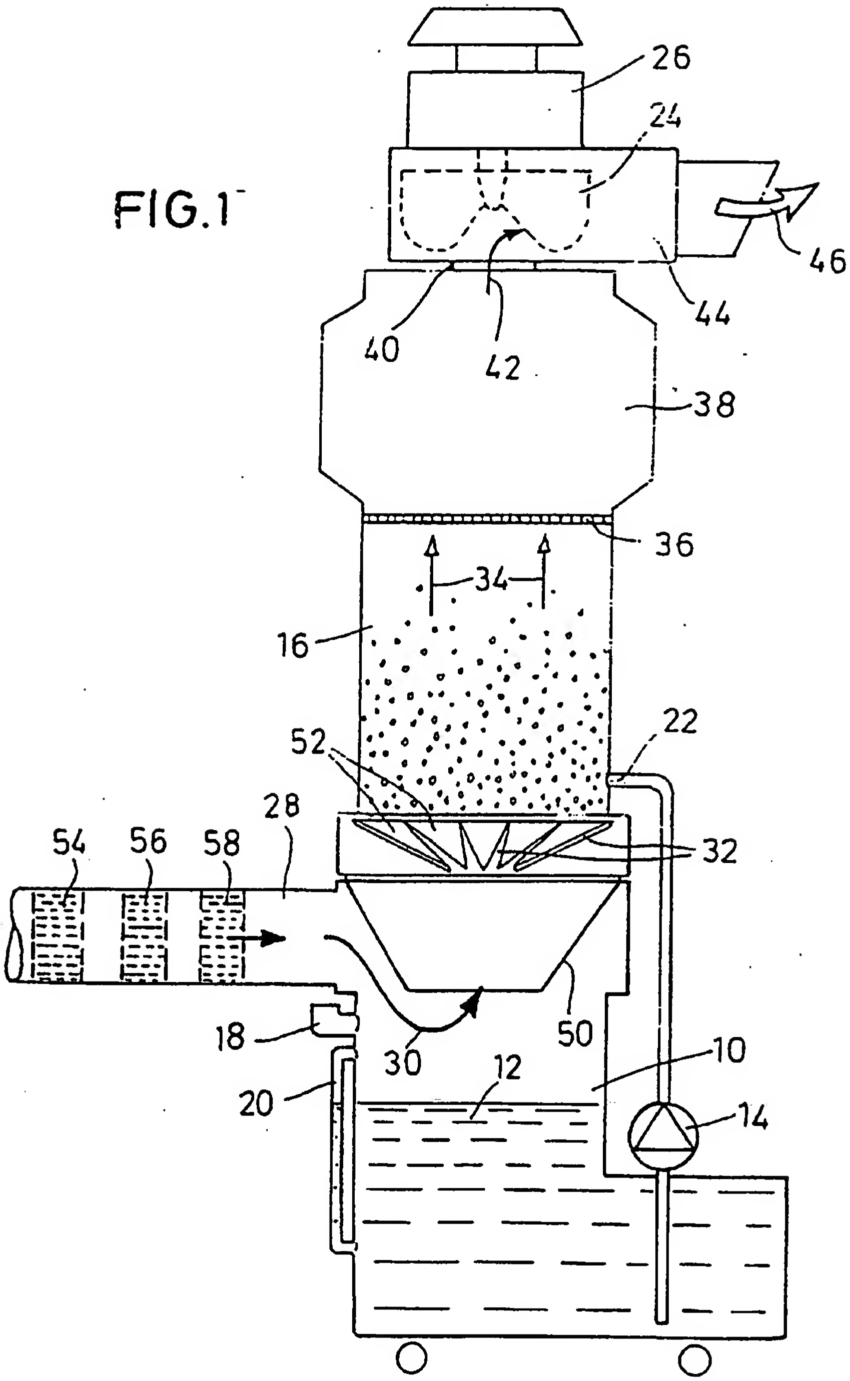
19. The device according to any of claims 10-18, characterized in that the mixture of air and vaporized air treatment agent (12) supplied to the space to be treated contains between 0.1 and 0.00001 ml, preferably between 0.01 and 0.0001 ml, of air treatment agent (12) per m^3 of air per hour.

20. The device according to any of claims 10-19, characterized in that the proportion of air treatment agent in the mixture of air and air treatment agent supplied to the space to be treated is ≤ 100 ppt, preferably ≤ 10 ppt.

21. The device according to any of claims 10-20, characterized in that an antimicrobial composition is used as said air treatment agent (12).

22. The device according to claim 21, characterized in that said antimicrobial composition contains one or more GRAS flavoring agents or their derivatives.

FIG.1



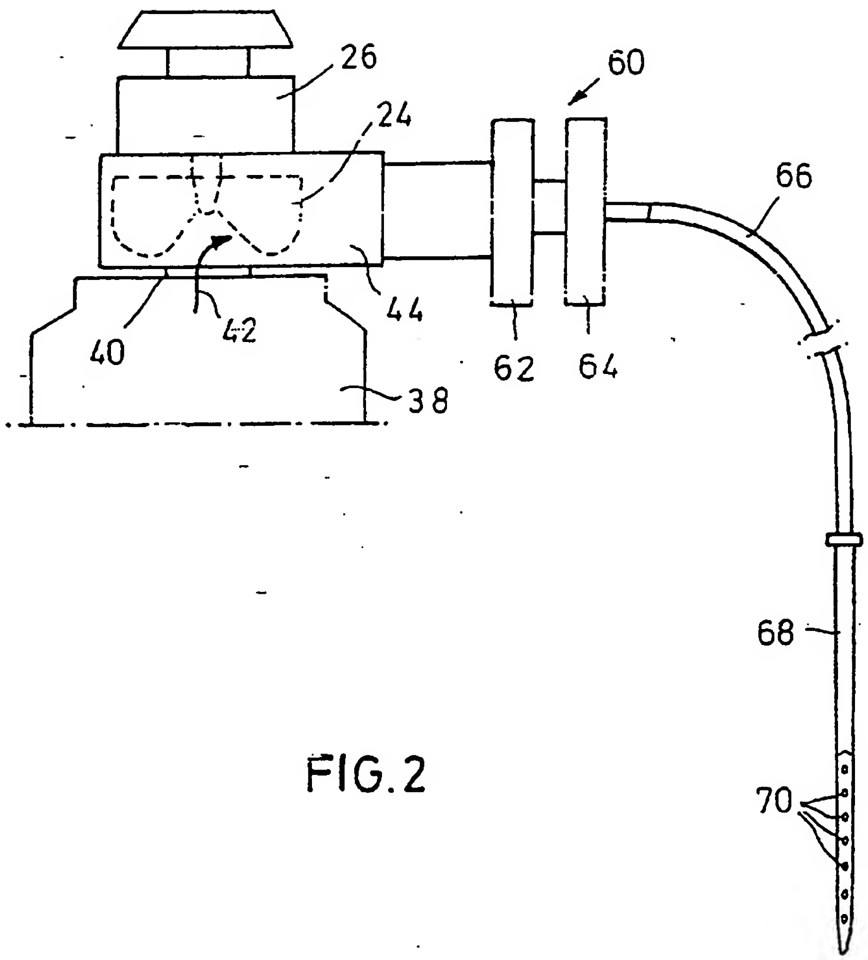


FIG.2